Space Weather Technical Forecast

Issued on Friday, 18 November 2022 at 13:24 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Slight chance of M-class flares (Minor to Moderate radio blackouts) throughout. Chance of G1 (Minor Storm) on 20 and 21 November.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity over the past 24 hours has been Low levels, with four significant C-class flares. The largest of these was a C5.6 at 14/0914UTC from either of the two complex sunspot regions which have rotated across the western limb over the last 24 hours. A number of mid-range C-class flares have been observed from this region, with a CME also being observed, but given the source location this is not likely to be Earth-directed. There are three numbered sunspots on the visible disc, which are all developing slowly, but which all appear benign and currently inactive. An unnumbered region is also developing in the northwest quadrant. No further Earth-directed CMEs have been observed in available imagery.

Solar Wind / Geomagnetic Activity: The solar wind as observed at L1 by ACE/DSCOVR, has been predominantly at slow speeds declining from 390km/s to average around 315km/s since 18/0030UTC. Density started below average, but gradually increased to above average through the period, peaking at 20ppcc at around 18/0809UTC, due to the arrival of a slow moving CME which left the Sun on 14 November. Total magnetic field strength (IMF) has been weak throughout, but the north-south component switched to a weakly, but persistently negative polarity from around 18/0700UTC. Phi angle has been mainly negative (towards the Sun). Geomagnetic activity was Quiet.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES-16 has remained at background levels. High energy electron flux (greater than 2 MeV) at GOES-16 has been at background to moderate levels, with a peak of 245 pfu at 18/1225 UTC. Electron fluence levels remained well below Active (1e8 integrated pfu) levels, with a level trend. Observed fluence at 18/0001 UTC was 5.31e6 integrated pfu.

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Met Office Space Weather Technical Forecast

Four-Day Space Weather Forecast Summary
Solar Activity: Solar activity is expected to be mainly Low or Very Low, with a slight but decreasing chance of M-class flares, due to the continued activity from the two complex regions which recently rotated across the western limb.

Solar Wind / Geomagnetic Activity: A CME has affected the Earth on 18 November, with no significant geomagnetic effects expected from this feature. No further Earth-directed CMEs are forecast. Solar winds speeds are forecast to be at mainly background levels on 18 November, with limited effects from the recent CME arrival. Speeds are then likely to increase either late on 19 November, but most likely on 20 November due to the onset of the high speed stream from coronal hole 46, giving speeds in the region of 500km/s. These speeds are then expected to continue through 21 November. Geomagnetic activity is forecast to be mainly Quiet to Unsettled through 18 November, with a low chance of Active due to CME effects. Unsettled to Active intervals are then expected to develop either late on 18 November, but most likely through 20 and then 21 November, due to the connection with the high speed stream. There is a chance of G1/Minor Storms associated with this feature, although negative coronal holes are not favoured for a strong connection at this time of year.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) observed by GOES-16 is most likely to remain at background levels throughout. There is initially a slight chance of a solar radiation storm from the two complex regions located beyond the northwest limb. Electron flux is forecast to remain at mostly background to moderate levels throughout the period. Fluence values are expected to remain below or well below the Active (1e8 integrated pfu) threshold throughout.

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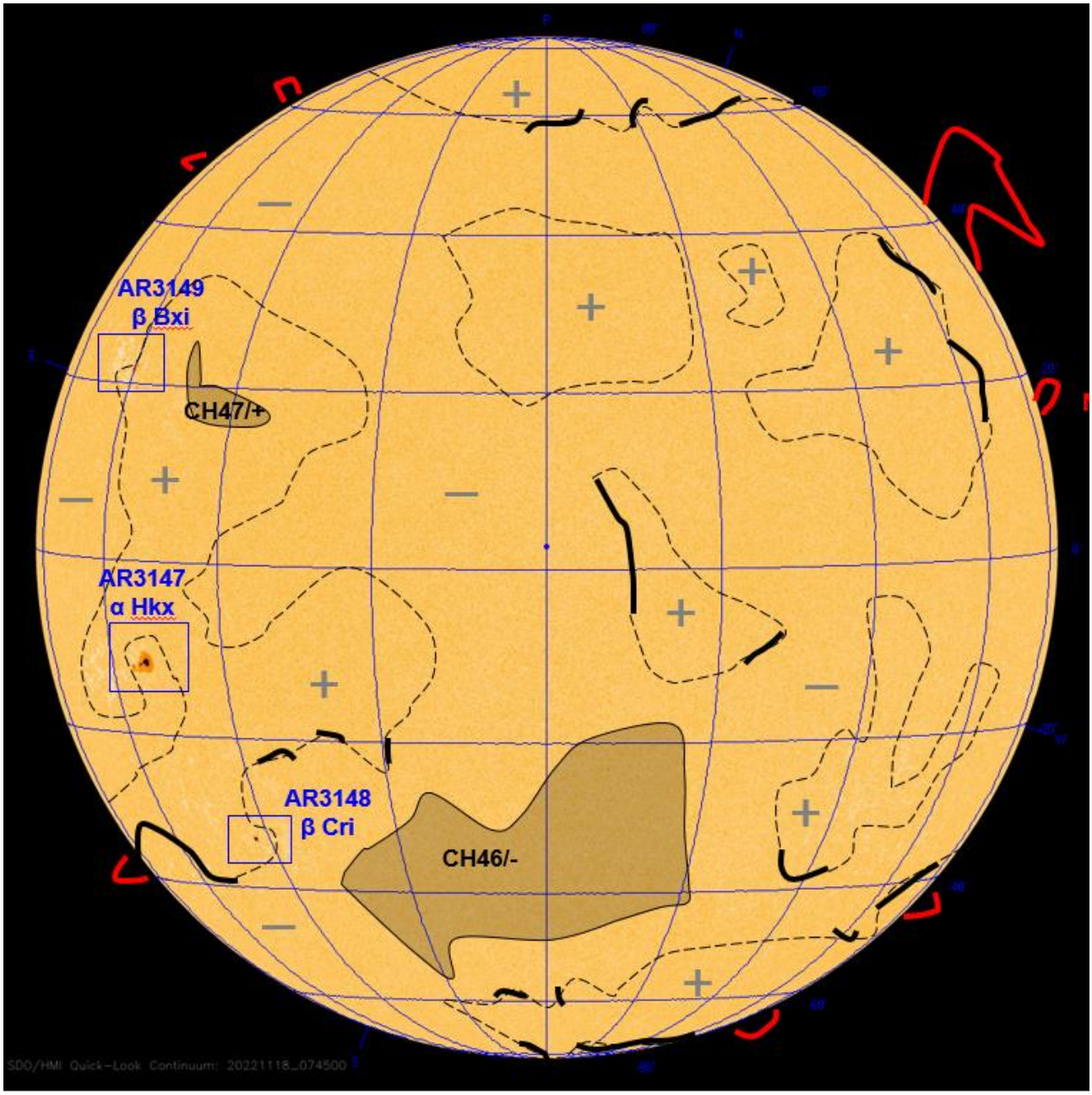
Figure 1. Solar Analysis Valid 18/0800UTC.



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Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:
A CME which left the Sun on 14 November appears to have arrived at Earth on 18 November. This arrival resulted in a slight density peak and a weak magnetic cloud, but given the relatively slow speed, at around 300-350km/s, only limited geomagnetic response is expected.
Coronal hole 46 is then due to connect with the Earth possibly late on 19 November but more likely during 20 November, based on persistence and an estimated solar wind speed of around 500km/s. There is a chance of G1/Minor storms due to the onset of this feature, but as this is a negative coronal hole, a strong connection to the high speed stream is not favoured for this time of year.

Mainly Quiet to Unsettled intervals are expected through the next 24 hours, with slight enhancements due to CME effects, possibly reaching Active levels. Chance of Active levels and slight chance of G1/Minor Storms on 19 November due to any possible connection to the high speed stream from coronal hole 46 Chance of Active or G1/Minor Storm levels through 20 and 21 November due to a high probably of connection to the coronal hole high speed stream.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	20	30	30
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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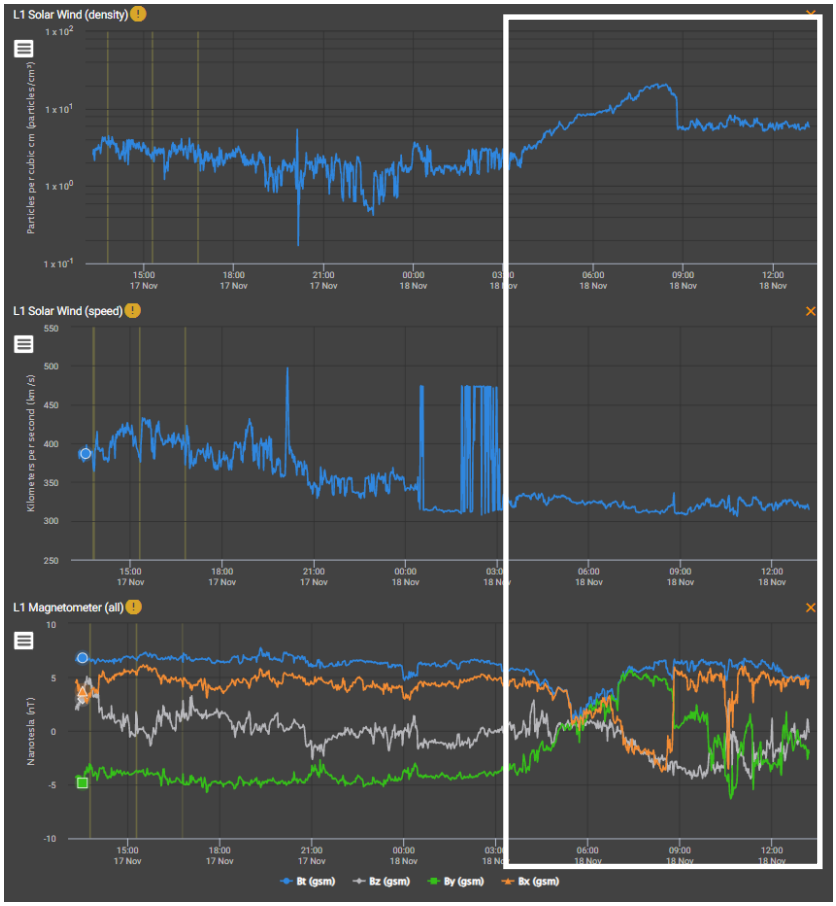
Figure 2: 24 hour solar wind data from DSCOVR at L1. The recent changes due to the CME arrival are highlighted.



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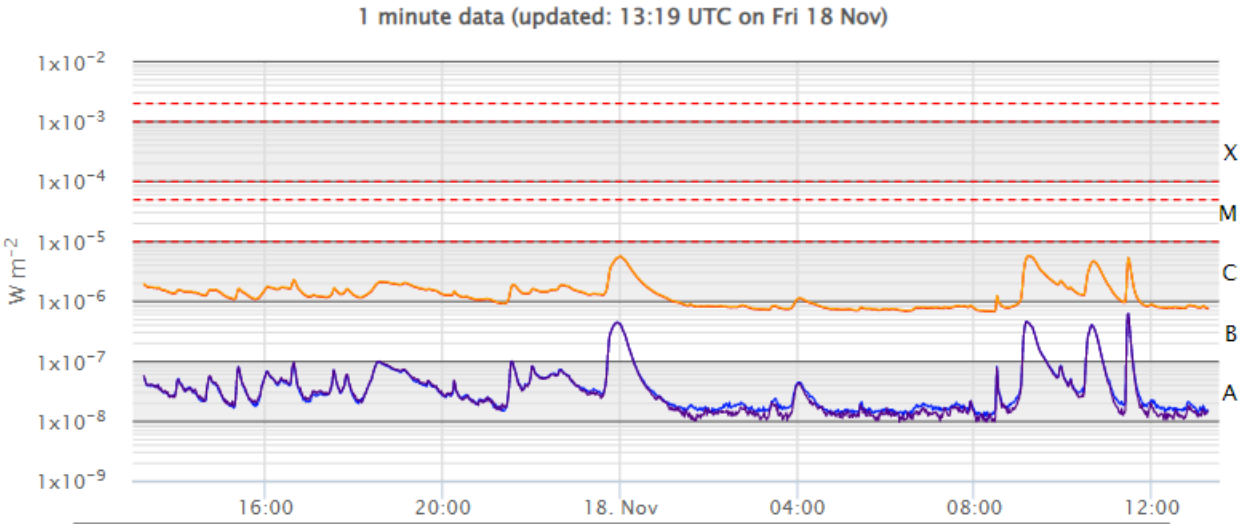
Radio Blackouts - X-Ray Flares:
There are three numbered sunspot regions on the visible disc, all relatively benign in the eastern hemisphere and only evolving slowly. A further unnumbered region in the western hemisphere is also evolving slowly. The most active region has been the complex region which rotated across the northwest limb on 17 November. This has produced multiple flares and a CME over the last 6 hours and is still considered to be the greatest risk area for further flare activity, despite the farside location.

Mainly Low or very Low activity is forecast, with a slight chance of Moderate flares. There is a limited chance of X-class flares on 18 November due to the activity from the region just beyond the western limb.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	20	10	10	10
Very Active	R3 to R5 X Class	No	5	1	1	1

Figure 3: GOES 16 X-ray flux



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) at GEO, as observed by GOES-16, is currently at background levels and is most likely to remain at this level throughout the period. However, the diminishing presence of AR3140 and AR3141, now beyond the northwest limb, initially poses a slight risk of proton storms above background conditions.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	2	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

Electron flux (greater than 2MeV) is at background levels and is forecast to be at background to moderate levels through much of the forecast period, with radiation belt modelling suggesting a muted electron belt forecast, with GOES-16 expected to remain outside the main region of electron belt density. This is likely to be due initially any geomagnetic activity displacing electron belts away from satellite orbits, but also due to the expected onset of the high speed stream later in the period, which is likely to compress the radiation belts away from satellite orbits.

MOSWOC REFM models suggest that electron fluence values will remain below the Active threshold, with this trend accepted, based on electron flux forecasts.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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